3.0 Water Capacity

The Pennichuck water system provides water to the city of Nashua through the Infilco Degremont Treatment Plant and a series of storage tanks and distribution mains. The water source for the treatment facility is provided through a series of four impoundments (Holts Pond, Bowers Pond, Harris Pond, and Supply Pond) and supplemented by withdrawals from the Merrimack River. The following sections provide additional detail relative to the water supply, treatment and distribution systems. In addition this section discusses the future supply and demand, drinking water regulations and capital improvements.

3.1 Water Supply System

Pennichuck Water Works, Inc. supplies water to the City of Nashua and limited areas of the Towns of Amherst, Merrimack, Milford, Hollis, Bedford, Derry, Plaistow, Epping, Salem and Newmarket. The sole source of water for the City of Nashua and the Towns of Amherst, Merrimack, Milford, and Hollis is surface water in the Pennichuck Brook and Merrimack River Watersheds, while the Towns of Derry, Plaistow, Bedford, Epping, Salem and Newmarket obtain their water through a series of wells.

Consisting of approximately 18,000 acres, the Pennichuck Brook watershed lies within the towns of Nashua, Merrimack, Amherst, Milford and Hollis. The chain of ponds that supply the water to the Pennichuck system consists of Stump Pond, Pennichuck Pond, Holtss Pond, Bowers Pond, Harris Pond and Supply Pond. Water is withdrawn from Harris Pond and brought to the Water Treatment Plant. During drought or dry months, typically during the summer, water from the Merrimack River is pumped into Bowers Pond to supplement the demand at the Water Treatment Plant. By pumping into the Pennichuck Brook system, this system is the sole source of water with no secondary or back up source of water.

The water supply of the core system for Pennichuck Water Works is primarily from the chain of ponds on the Pennichuck Brook. The table on the following page summarizes the characteristics of the supply pond system based on the July 2000 study prepared by Comprehensive Environmental, Inc. (CEI) and the December 1914 study prepared by Metcalf & Eddy.

Table 3-1 Pond Characteristics

	Drainage Area (Acres)	Surface Area (Acres)	2000 Pond Storage (MG)[1]	1914 Pond Storage (MG)[2]
Holtss Pond	14,171	23	Unknown	35
Bowers Pond	15,955	92	180	225
Harris Pond	17,199	78	340	375
Supply Pond	17,598	16	Unknown	54
Total	**64,923**	**209**	**520+**	**689**

1 Taken from "Sediment Study of Pennichuck Ponds" prepared by CEI, dated July 2000.

2 Taken from "Report Upon the Property and Business of the Pennichuck Water Works" prepared by Metcalf & Eddy, dated December 1914.

Based on the recommendations in the July, 2000 study prepared by CEI, **all of the four supply ponds have accumulated sediment to depths of four feet and three of them are in need of dredging**. The following table summarizes the results of the "Sediment Study of Pennichuck Ponds."

Table 3-2 Pond Sediment Summary

	Max. Pond Depth (Feet)	Sediment Volume (cubic yds)	Sediment Volume (Million Gallons)	Recommendations
Holtss Pond	6	59,000	11.9	Mechanical dry dredging since it has the capability to be dewatered.
Bowers Pond	20	238,000	48.1	Upstream section – either dry or hydraulic dredging Downstream section – mechanical dry or hydraulic dredging
Harris Pond	26	243,000	49.1	Due to the location of the intake for the treatment plant, hydraulic dredging may be the most appropriate
Supply Pond	19	33,000	6.7	Since this pond was recently dredged it should be monitored and sediment removed if needed.
Total*		540,000	109.1	

Source: "Sediment Study of Pennichuck Ponds" prepared by CEI, dated July 2000.

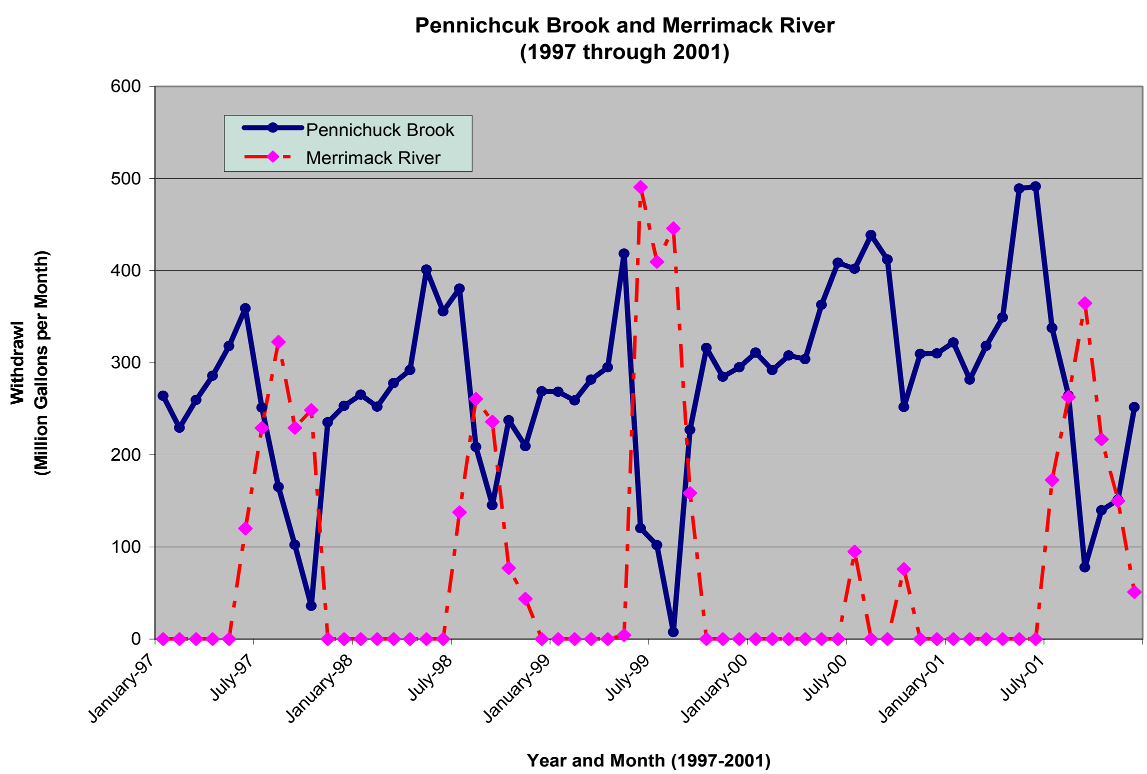
* Based on the recommendations the total does not include Supply Pond Values

Based on this study, three of the ponds are in need of dredging in order to maintain the storage capacity in the pond system and ensure the future supply of water to the treatment facility. **Based on removing 540,000 cubic yards (109.1 Million gallons) these recommendations, the cost associated with dredging the three ponds is approximately $21,600,000.**

The secondary source of water for Pennichuck is from a pumping station on the Merrimack River. This water is pumped to Bowers Pond to supplement the water in the Pennichuck Brook system. The current pumping system consists of two pumps that have a capacity to convey up to 16.2 million gallons per day (MGD). The ACOE permit allows for a maximum withdrawal of 30 MGD. When a third pump is added to this pumping station the withdrawal capacity of the pumps will be increased to 24 MGD based on the "Integrated Water Resource Plan," prepared by Pennichuck Water Works dated September 1998.

The raw water usage by the core system of Pennichuck Water Works is presented in Figure 3.1 for the last five years. As shown in the graph the primary source is the Pennichuck Brook system during the winter months and years with average or above average precipitation. During the summers of dryer years (1997, 1998, 1999 and 2001) the Merrimack River supplements Pennichuck Brook and in some cases is the primary source. This was the case in August, 1999 where the Pennichuck Brook system contributed 7 million gallons, while the Merrimack River provided 446 million gallons. The monthly water usage data from 1995 to 2001 is provided in Appendix D.

Figure 3.1 - Monthly Water Usage



Source: Monthly Water Usage provided by Pennichuck through the PUC proceeding process.

With the Merrimack River water being discharged to the Pennichuck Brook system, Pennichuck does not have a secondary source or back up source of water supply. This leaves Pennichuck Water Works venerable. With the proximity of Route 101A, Route 3 and several residential roads, the potential for contamination of the water source is of critical importance. An alternate source or secondary back up to the Pennichuck Brook system should be investigated to insure future supply to the customers of Pennichuck Water Works.

3.2 Safe and Permitted Yield

The safe yield of a supply system is the amount of water that can be withdrawn without taxing the environment or causing damage to the system during a drought. The frequency typically used to define the severity of the drought conditions is 100 years. Based on review of the Weston & Sampson report from 1975 and the Pennichuck Water Works report from 1998, the safe yield of the pond system is 6 MGD during a drought year and the average daily yield is 30 MGD. The Merrimack River pumping facility capacity is currently 16.2 MGD. The current Army Corps of Engineers (ACOE) withdrawal permit for the Merrimack River limits withdrawals from the Merrimack River based on the following:

- 30 MGD “when the river level at the intake structure is above 91.2 feet MSL”
- 20 MGD “when the river level falls below 91.2 feet MSL” provided “that a minimum flow of 1.3 cubic feet per second per square mile of drainage (cfsm) will be maintained below the water intake during the months of May and June and maintain a minimum flow of 0.5 cfsm at all other times”
- 12 MGD if the “river flows fall below the minimums noted above”

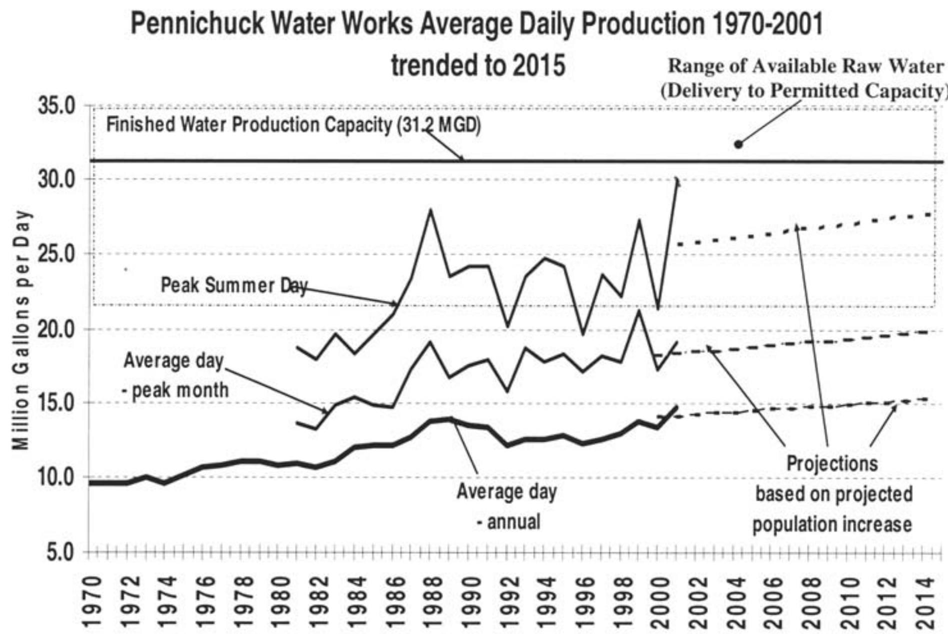
The permitted yield of the supply system ranges from 18 to 36 MGD depending on the flow in the Merrimack River.

Figure 3.2 below shows the flow from the treatment facility for the last 30 years. Based on the flow records, the maximum daily flow of 30 MGD was reached in the summer of 2001. Also the average daily flows during the peak summer months have exceeded 18 MGD as recent as 1999 and 2001.

The current ACOE withdrawal permit for the Merrimack River is valid until December 31, 2004. At that time the permit will need to be renewed with the ACOE. Based on pending NHDES regulations, future withdrawal permits may include additional limitations relative to base flow within the Merrimack River. With the Merrimack River being the primary source during the summer months (refer to Figure 3.1), it is critical for the City of Nashua and surrounding towns of Hollis, Merrimack, Milford and Amherst to be key players in the future regulations of the Merrimack River.

Future restrictions on the Merrimack River could prove to be problematic for the core system by limiting the withdrawal rate from the Merrimack River during dry periods of the year and may therefore limit the ability for Pennichuck to provide water to the City of Nashua and the surrounding communities.

Figure 3.2



Taken from Pennichuck Water Works "Integrated Resource Plan." Included in Appendix E. Population projections based on Pennichuck's estimate for population increases.

Based on the safe yield, which could be as low as 18 MGD in the summer, the Pennichuck water supply system could face capacity problems in the future. Actions should be taken to ensure that the system has sufficient water supply to accommodate the current needs and peak demands of the consumers as well as projected demands. These actions could include provision of an additional water source, incorporation of regulatory water bans, incorporation of more efficient facilities, evaluating and upgrading the distribution system to eliminate leaks, etc. More detail is provided in Section 3.4 relative to future supply and demands.

3.2.1 Raw Water Supply

In addition to long term safe yield issues, the system should be able to supply short term maximum daily flows that account for customer demand and a reserve, typically 20%, to account for un-metered losses in the treatment plant and distribution system.

In addition to water quantity, the quality of the raw and finished water is important. Past analysis of the Merrimack River and the Pennichuck Brook supplies illustrated a raw water with color values from 15 to 60 platinum-cobalt colors units (PCU), turbidities of 0.4 to 1.0 Nephelometric Turbidity Units (NTU), and pH from 6.3 to 6.8. In addition m-alkalinity as C_aCO_3 is low and coliform densities are high. The concern over the years has primarily been with turbidity control (due to the lowering of the finished water turbidity standard), and elevated microbiological and chemical parameters for which the treatment plant was not originally designed. Additional water quality concerns stem from the following:

1. more stringent drinking water regulations not conceived at the time of design and construction, and

2. degradation of the source may challenge these facilities and operations.

Pennichuck relies heavily on the water treatment plant and does not emphasize watershed protection as a means to improve water quality. This results in severe degradation of raw water quality and taxes the treatment plant, therefore requiring additional treatment and potentially additional costs for the treatment system. This concept is described in greater detail in Section 4.2.

High turbidity values are also supported by the recent press release dated September 3, 2002 relative to the copper sulfate treatment of Harris and Bowers Ponds to control the blue-green algae currently blooming in the ponds. This measure was required to decrease the turbidity within the ponds in order to meet the EPA turbidity standard. One of the major reasons for the algae bloom is phosphorus in the ponds as discussed further in Section 4.1.2, Water Quality of the watershed.

3.3 Water Treatment Facility

The Pennichuck Infilco Degremont treatment plant has a rated capacity of 31.2 million gallons per day (MGD). It is located in Nashua and provides treatment using physical/chemical removal of suspended solids and sand and carbon filtration. The Plant was built in 1980 and has been in operation since. The major components of the Plant are as described below:

Clarifier. The Pulsator flocculator-clarifier removes turbidity and color from the raw water prior to filtration. A mixture of alum and sodium aluminate is used to develop a coagulant and an anionic polymer (Nalco 8174) is used to help develop the floc ("sludge blanket"). The raw water mixed with the coagulant is fed upwards through a previously formed sludge blanket in a cycling or pulsating flow. The Pulsator Clarifier consists of a flat bottom tank with a vacuum chamber and associated piping. The clarified water that is separated from the sludge blanket is collected near the surface with a submerged orifice launder take-off system.

Filtration. The Aquazur V is a rapid gravity filter system with dual media (sand and carbon). The system consists of a rectangular tank that is divided longitudinally into two filtration bays by a center channel. Water to be filtered is fed to a battery of filters from a distribution channeling system. The underdrain system is generally constructed of 2 foot square concrete slabs fitted with long stem plastic air diffuser nozzles. During the filtering cycle water drains through the underdrain nozzles into the filtered water plenum and discharges into the clearwell. During the backwashing cycle both filtered water and pressurized air travel a reverse path into the plenum below the slab and escape through the underdrain nozzles into the main basin.

Costs associated with capital improvements for the treatment facility have been included in the following section in Table 3-3. Additional information relative to upgrades to the treatment facilities in order to meet future regulatory requirements has been provided in Section 3.6.

3.4 Water Distribution System

Pennichuck Water Works, Inc. provides water to 23,634 customers (based on the Annual Report submitted to the PUC dated December 31, 2001) within the City of Nashua and limited areas of the Towns of Amherst, Merrimack, Milford, Hollis, Bedford, Derry, Plaistow, Epping, Salem and Newmarket. Table 1.2 and Figure 1.1 presented the breakdown of customers served by Pennichuck Water Works by municipality.

As presented in Section 1.3 the distribution system for Pennichuck Water Works and that portion of the system within the City of Nashua is as follows:

	PWW	**City of Nashua**
Distribution and transmission lines	397 miles	300 miles
Water meters	23,820	20,000
Hydrants	2,223	2,000
Well systems	2	0
Water intake plant	1	0
Storage tanks	11	5
Water treatment plant	1	1

Tables 3-3 on the following page presents a summary of the various components of the water treatment and distribution systems within the City of Nashua along with the replacement costs based on the report prepared by George E. Sansoucy dated April 1, 1995.

Based on the drawings for the distribution system, it appears that very little planning went into the layout of the distribution system within the City of Nashua and that the layout of the system is the result of small additions or expansions on the peripheral areas of the City of Nashua. **Due to the lack of information provided by Pennichuck Corporation, the following aspects of the distribution system are unknown at this time. As a result, comments/recommendations can not be made as to the following:**

Hydraulic capacity within the system,

High or low pressure areas,

Fire protection,

Areas of concern within the City, and

Areas of concern.

Table 3-3 Summary of Water Distribution System

Description of Component[1]	Quantity	Capacity	Replacement Cost (New)
I. Distribution and Transmission Mains			
Pipe – 0.75 to 24'	1,613,800 LF		$57,474,000
Fittings – Reducers, Tees, Blind Flanges	3,949		$1,551,000
Thrust Blocks	5,020		$377,000
Valves - System Isolation, Presure Reducing & Check	3,604		$3,961,000
Indirect costs and AFUDC			$14,546,000
Sub-Total			**$77,909,000**
II. Services			
Pipe – ½ to 12	19,340 LF		$11,940,000
Indirect costs and AFUDC			$2,741,000
Sub-Total			**$14,681,000**
III. Meters			
Residential – 5/8 and ¾	18,558		$1,874,000
Commercial – 1, 1-1/2, 2	900		$268,000
Industrial – 3, 4, 6	79		$77,000
Special – 8 and 12	2		$6,000
Indirect costs and AFUDC			$179,000
Sub-Total			**$2,404,000**
IV. Booster Pump Stations			
Kessler		400 gpm	$60,000
Main Dunstable		2,000 gpm	$178,000
Skymeadow		1,100 gpm	$55,000
Shakesphere		90 gpm	$62,000
Timberline		500 gpm	$222,000
Coburn		600 gpm	$44,000
High Pine [2]		6,750 gpm	
Orchard Ave [2]		270 gpm	
Snow [2]		5,000 gpm	
Sub-Total			**$621,000**
V. Storage Tanks			
Columbia Road [3]		2.8 MG	$867,000
Fifield Avenue #1		5.0 MG	$1,390,000
Fifield Avenue #2 [2]		6.6 MG	
Shakespeare Road #1		1.0 MG	$413,000
Shakespeare Road #2		1.7 MG	$563,000
Kessler Farm		4.5 MG	$1,302,000
Sub-Total			**$4,535,000**
VI. Fire Hydrants	2,047		**$3,646,000**
VII. Water Treatment Plant		35.0 MG	**$9,334,000**
VIII. Dams			
Holts		23 Ac	$38,000
Bowers		92 Ac	$644,000
Harris		78 Ac	$1,224,000
Supply Pond		16 Ac	$1,409,000
Sub-Total			**$3,315,000**
Total			**$116,445,000**

Units: LF-Linear Feet MG-Million Gallons gpm-Gallons per Minute Ac.-Acres of surface area

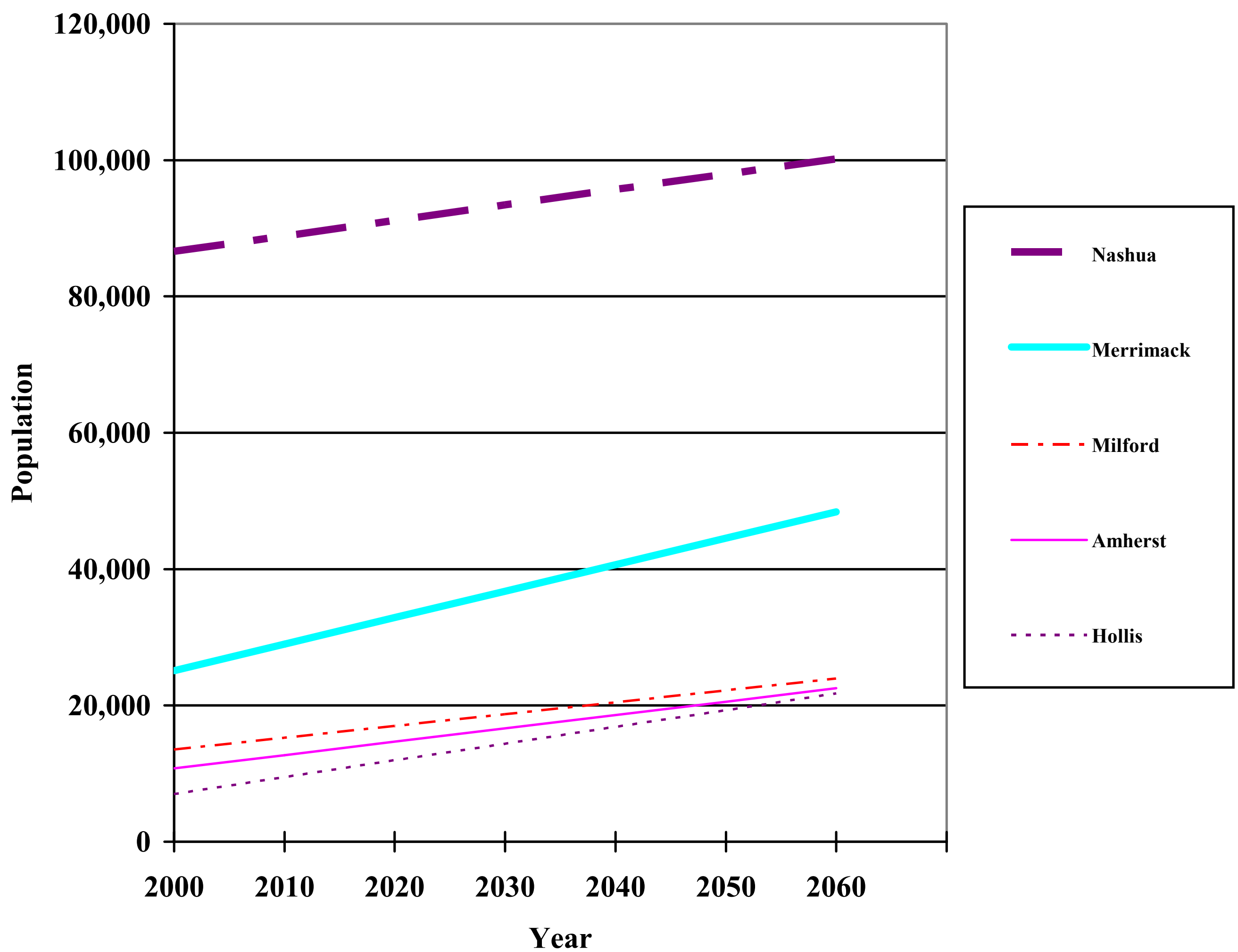
1 All sizes are in inches unless otherwise stated.
2 Installed after 1995 and hence not included in costs
3 Removed from service in 1998

Source:Table 3 – Detailed Summary of Replacement Cost New Less Depreciation as of 12/31/94

3.5 Future Supply and Demand

The future water demand is estimated based on the population growth projections in the City of Nashua and neighboring towns of Hollis, Merrimack, Milford and Amherst. The population for year 2000 were obtained from US Census and the estimates for year 2020 were made by the Nashua Regional Planning Commission (NRPC) and the Planning Agencies for Nashua, Hollis, Merrimack, Milford and Amherst. Figure 3.3 below presents the above population information for the five communities to the year 2060.

Figure 3.3 - Estimated Population Growth



Pennichuck Water Works, Inc. provides water to approximately 23,600 services (based on the Annual Report submitted to the PUC for the year ending December 31, 2001). The population served is estimated at 82,000 persons based on the distribution maps provided by Pennichuck Corporation. This is approximately 3.5 persons/service and approximately 60% of the total population in the five communities. The number of customers for the years 2010 through 2060 was estimated using this percentage of total population.

The average number of people served per month in 2001 was 82,000 with an annual consumption that year of 4.97 billion gallons. This translates to an average annual daily demand of 14 MG. Using a peaking factor of 2 the daily peak summer demand for 2001 is estimated at 28 MGD. Table 3-4 presents the peak daily demand for the years 2010 to 2060.

Table 3-4 Projected Daily Peak Demand

Year	Total Population[1]	Served by Pennichuck[2]	Average Annual Demand (MGD)	Peak Summer Demand (MGD)	Population Source
2000	**143,000**	82,000	14.0	28.0	Population – US Census
2010	**155,400**	89,100	15.2	30.4	Projected Estimates
2020	**167,700**	96,000	16.4	32.8	Town Estimates
2030	**180,000**	103,000	17.6	35.2	Projected Estimates
2040	**192,300**	110,200	18.8	37.6	Projected Estimates
2050	**204,600**	117,200	20.0	40.0	Projected Estimates
2060	**216,900**	124,300	21.2	42.4	Projected Estimates

1 Includes the City of Nashua and the Towns of Hollis, Merrimack, Milford and Amherst
2 Estimated based on the water system maps provided by Pennichuck and the Annual Report dated December 31, 2001.

The estimated summer daily demand of 28 MGD for year 2002 exceeds the 18 MGD safe yield for the summer months, but is within the range of the safe yield (18 – 36 MGD). **It appears that alternative sources of water supply could be needed at this time if the 12 MGD limitation on the Merrimack River and a drought year (limiting the supply ponds to 6 MGD) occurred simultaneously.** Based on the average annual demand, additional water sources would be needed prior to the year 2040.

Additional supply could be obtained by the reactivation of water supply wells which were historically utilized by the Pennichuck Water Company prior to conversion to the Merrimack River Supply. Three (3) additional wells could also be drilled in a cost-effective fashion to provide adequate water supply for near term deficits. It is anticipated that this program would involve approximately $1.3 million for the new water supply facilities and in excess of $1 million for related hydrological, testing, reactivation, well rehabilitation, and related raw water piping requirements. In the future, such assets may be considered as peaking/fire flow assets and be maintained in the system without primary responsibility. It is preferred to have a singular major water treatment facility from which to obtain the economy of scale of operations.

Blending analyses of these two sources over the range of conditions in relationship to the current and promulgated regulations is appropriate.

3.6 Drinking Water Regulations

Regulations relative to drinking water have a significant impact on the required capital improvements for both investor and municipal owned utility companies. This section provides an assessment of future regulations relative to water utilities and the potential impact to the Pennichuck water supply treatment and distribution systems. Based on the anticipated future regulations capital improvement costs to the Pennichuck Water Works water system have been estimated.

3.6.1 Regulatory Requirements

Two decades ago, the Safe Drinking Water Act (SDWA) Amendments of 1986 set a schedule for the establishment of new regulations. Numerous new National Primary Drinking Water Regulations (NPDWRs) were proposed or promulgated each year from 1988 through 1994. On August 6, 1996, President Clinton signed the SDWA amendments of 1996 into law as Public Law (PL) 104-82. The 1996 Amendments made comprehensive changes to the existing SDWA, creating several new programs to improve the protection of public health and bring reason and good science to the regulatory process.

The protection of public health, however, can be costly. Recent discussions at the federal level have focused on cost/benefit and risk/benefit decision analyses. In the case of future regulations such as arsenic and radon, the United States Environmental Protection Agency (USEPA) has been evaluating the public health benefits of stricter regulations while considering the financial burden that several utilities and that ultimately their customers would need to bear. The USEPA and the United States Congress realize that the promulgation of such regulations must have affordable and sustainable solutions.

Other potential regulations that have forced the USEPA to evaluate affordability and risk trade-offs include those for microbials and disinfectants and disinfection by-products (D/DBPs). It will be important for the USEPA to promulgate regulations that provide protection from microbial pathogens while simultaneously ensuring a decrease in health risks to consumers from disinfection by-products. The need to balance these risks will be evident in the future formulation of the Long Term One Enhanced Surface Water Treatment Rule (LT1ESWTR), the Ground Water Rule (GWR), the Long Term Two Enhanced Surface Water Treatment Rule (LT2ESWTR), and the Stage 2 D/DBP Regulations. The most recent rule promulgated relative to microbial control was the Filter Backwash Recycling Rule (FBRR) in June 2001.

It is essential to understand this dynamic regulatory environment for successful design of drinking water facilities and implementation of drinking water programs. Water treatment facilities must consider the current regulatory environment so that their strategic planning allows for compliance with existing and future regulations within the required time frames.

Water treatment and distribution facilities must meet the requirements of the New Hampshire Department of Environmental Services (NH DES) and United States Environmental Protection Agency (USEPA). The law that applies to Pennichuck Water Works is the SDWA (Public Law 93-523), as amended in 1986 and 1996. The purpose of these rules and regulations are to ensure that public supply of drinking water meet the minimum requirements of the SDWA.

The following subsections describe the federal and state regulations that apply to Pennichuck Water Works at the time of this writing.

3.6.2 SDWA Amendments

The changes to the SDWA resulting from the June 1986 Amendments had a direct impact on the type and operation of water treatment and distribution facilities that provide potable water. The regulatory requirements take the form of new regulated contaminants, more stringent permissible maximum contaminant levels, increased monitoring requirements and stricter enforcement penalties. This subsection provides a brief summary of some of the directives contained in the SDWA Amendments of 1986 that will provide an understanding of the mandates established by Congress to guide the drinking water regulation program. The significant directives of the SDWA Amendments of 1986 and the corresponding section numbers are summarized below:

1. Section 1412(a)(1) directs that all previously promulgated National Interim Primary Drinking Water Regulations (NIPDWR) and revised primary drinking water regulations be deemed as National Primary Drinking Water Regulations (NPDWR).

2. Section 1412(a)(2) requires that all recommended maximum contaminant levels (RMCL) previously published be treated as maximum contaminant level goals (MCLG).

3. Section 1412(a)(3) requires that MCLG's be published simultaneously for any new NIPDWR which proposes a maximum contaminant level (MCL).

4. Section 1412(b)(1) establishes a source list of 83 contaminants to be regulated and a time frame for these regulations to be enacted. These contaminants are categorized into Inorganic, Organic and Microbiological as presented in Appendix F. The regulation of these is summarized below:

    a. 9 contaminants within 12 months of enactment.

    b. 40 contaminants within 24 months of enactment.

    c. Remaining contaminants within 36 months of enactment.

5. Section 1412(b)(2) allows the USEPA to substitute up to seven (7) contaminants onto the original list of 83, if they are more likely to be protective of public health.

6. Section 1412(b)(3) directs USEPA to publish MCLG's and MCL's for each contaminant which may have an adverse effect upon the health of persons and is known or anticipated to occur in public drinking water systems. This list of additional contaminants was published on January 1, 1988 and republished in subsequent 3 year intervals. MCLG's and MCL's are to be published for 25 of these contaminants within 24 months of listing and for the remainder within 36 months.

7. Section 1412(b)(4) provides for the setting of MCL's as close as is feasible to MCLG's which are to be set at a level at which no known or anticipated adverse health effects occur with an adequate margin of safety.

8. Section 1412(b)(5) defines the term "feasible" based on the use of best available technology (BAT) and defines BAT for synthetic organic chemical (SOC) as the use of granular activated carbon.

9. Section 1412(b)(6) requires that BAT be listed for each MCL established.

3.6.3 SDWA Amendments Implementation

The USEPA Office of Drinking Water is responsible for implementation of the regulations mandated by the 1986 SDWA Amendments. The Amendments followed the publication in 1982 and 1983 by USEPA of a list of 83 contaminants the USEPA believed should be controlled by setting MCL's. The 1986 Amendments directed the USEPA to establish MCL's for all 83 contaminants within 3 years and subsequently add an additional 25 contaminants every 3 years. This schedule of additional contaminant regulation every 3-years has been restructured in the 1996 Amendments (discussed further in the next paragraph) due to the lack of resources required to thoroughly investigate 25 contaminants every 3 years. Thus, the requirement that EPA regulate an additional 25 contaminants every 3 years has been eliminated. Instead, EPA has the flexibility to decide whether or not to regulate a contaminant after completing a required review of at least 5 contaminants every 5 years.

The SDWA Amendments of 1986 set an aggressive schedule for the establishment of new regulations. Numerous new regulations were proposed or promulgated each year from 1988 through 1994. This accelerated pace has slowed considerably due to government shutdowns and resource limitations. As a result of these regulatory delays, the U.S. Congress and the USEPA realized that reform of the SDWA was necessary. This need for reform resulted in the U.S. House of Representatives passing bill H.R. 3392 in 1994 which set guidelines for SDWA reform. This legislative action was followed by the U.S. Senate passing bill S.1316 in 1995 which set guidelines for SDWA reauthorization. Due to major differences between the two (2) bills, a new bill had to be passed by the House to reconcile it with the Senate S.1316 bill. On June 26, 1996, the House passed a bipartisan SDWA reauthorization bill (H.R. 3604) which was similar enough with Senate Bill S.1316 that the SDWA was reauthorized in the 104th Congress.

As a result of this legislative action, on August 6, 1996, the President signed the SDWA amendments into law as Public Law (PL) 104-182. The new amendments made changes to the existing SDWA, created several new programs that will improve the protection of public health, and brings reason and good science to the regulatory process. The SDWA reauthorization also allocated more than $42 billion in federal funding for various drinking water programs and activities from fiscal year (FY) 1997 through FY 2003.

3.6.4 SDWA Regulations and Effect on Current Treatment

The research and data associated with the rules covered in this section are referenced from the most recent material related to each regulation or rule.

3.6.4.1 Disinfection By-Product (DBP) Rule

Development of this rule began in 1989 when USEPA developed a proposal outlining its initial posture on the rule. The initial rule set an MCL on total trihalomethanes (TTHMs) of 100 micrograms per liter with no MCL set for total haloacetic acids (THAAs). The initial rule was superseded in December 1998 based upon the mandates of the 1996 SDWA amendments. The current rule is known as the Stage I Disinfection/Disinfection By-Product Rule (D/DBP). The Stage I D/DBP Rule applies to all community and nontransient noncommunity water systems that treat their water with a chemical disinfectant for either primary or residual treatment.

In the formation of this rule, EPA had to weigh the risks of cancer causing DBPs versus the risk presented by pathogens. The major changes to the rule include the lowering of the TTHM standard from 100 micrograms per liter to 80 micrograms per liter. In addition, a limit of 60 micrograms per liter has been set for THAAs. A TOC removal has also been set to require the removal of a certain percentage of DBP precursors from the raw water.

Previously, it appeared that the Stage II D/DBP regulations would lower the TTHM and THAA standard further from 80 and 60 micrograms per liter to 40 and 30 micrograms per liter respectively. Presently, the draft rule does not contain the provision for lowering the standard any further; however, to ensure protection of the public without decreasing the standards, EPA is moving toward an approach that would require a utility to look at their sampling events on a locational running annual average (LRAA) basis instead of as a running annual average (RAA). This would provide more stringent monitoring for individual locations that are likely to be suspected areas in the distribution system where DBPs may be more of a problem (e.g. Outer areas of the distribution system that may experience long chlorine contact times and thus the potential for higher DBPs).

Table 3-5 provides a summary of this rule and the disinfectants and disinfectant by-products that are regulated by this rule.

Table 3-5 Disinfection By-Product (DBP) Summary

Regulation	Max. Contaminant Level (MCL) (mg/L unless otherwise noted)	Potential Health Effects of Contaminant
Disinfectants		
Chlorine †	MRDL-4 (as Cl2)	Hemolytic Anemia In Dialysis
Chloramines †	MRDL-4 (as Cl2)	Hemolytic Anemia In Dialysis
Chlorine Dioxide ǂ	MRDL-0.8 (as Cl2)	Hemolytic Anemia In Dialysis
Disinfectant By-Products		
Total Trihalomethanes (TTHM4) ╫	0.080	Hemolytic Anemia
Haloacetic Acids (HAA5) ╫	0.060	Cancer Risk
Chlorite ǂ	1.0	Cancer Risk
Bromate ‡	0.010	Cancer Risk, Nervous System, Liver Effects
Total Organic Carbon (TOC)*	Treatment Technique	

Monitoring Requirements

† Monitor at the same sample locations as the total chlorine residual. Compliance based on running annual arithmetic average of monthly averages.

ǂ Daily sample at distribution system entry point.

‡ One (1) sample per month for ozonation systems and running annual average.

╫ Four (4) quarterly samples, compliance based on running annual average.

* TOC - Source and treated water TOC sampled once per month.

Comments:

The interim MCL for TTHM (4) of 0.10 mg/L has been replaced by the final Stage 1 D/DBP Rule promulgated in December 1998. The removal of TOC to reduce the formation of DPBs is achieved by the treatment technique of enhanced coagulation or enhanced softening that specifies the percentage of influent TOC that must be removed based on the raw water TOC levels and alkalinity. PWSs serving more than a population of 10,000 must comply by December 2001. PWSs serving less than a population of 10,000 must comply by December 2003.

TTHM (4) include chloroform, bromoform, dibromodichloromethane, and dibromochloromethane. HAA(5) include chloroacetic acid, dichloroacetic acid, trichloroacetic acid, bromoacetic acid and dibromoacetic acid.

3.6.4.2 Groundwater Rule

The amended SDWA of 1986 mandates the USEPA to set disinfection requirements for all public water systems. The Surface Water Treatment Rule (SWTR) was the first enacted rule to govern these requirements. The SWTR set disinfection requirements for surface supply sources and those groundwater sources under the direct influence of surface water. A proposed Groundwater Disinfection Rule (GWDR) was expected to follow in June 1993. Due to resource shortages within the USEPA infrastructure this proposal has been delayed until a proposed rule was issued in May of

2000. The GWDR is expected to address disinfection of source water, distribution system disinfection, qualification of operators, treatment technique requirements, MCLG's, natural disinfection allowance, monitoring and analysis requirements and provisions for variances and exemptions. The following bullet items present the major requirements of the proposed rule:

1. System sanitary surveys conducted by the State and identification of significant deficiencies

2. Hydrogeologic sensitivity assessments for undisinfected systems

3. Source water microbial monitoring by systems that do not disinfect and draw from hydrogeologically sensitive aquifers or have detected fecal indicators within the system's distribution system

4. Corrective action by any system with significant deficiencies or positive microbial samples indicating fecal contamination

5. Compliance monitoring for systems which disinfect to ensure that they reliably achieve 4-log (99.99 percent) inactivation or removal of viruses

3.6.4.3 Sulfate Rule

EPA is currently investigating whether to move sulfate from the secondary contaminant list to the primary list such that it will be federally enforceable. Currently the FAC standard for sulfates is set at 250 mg/L. The USEPA had originally agreed to schedule a proposal in August of 2001, but at this time it appears that the proposed rule will be delayed to gather additional comments from industry professionals. This rule would not be expected to have any impact on City operations.

3.6.4.4 Radon

Radon is a naturally-occurring radioactive gas that may cause cancer, and may be found in drinking water and indoor air. Some people who are exposed to radon in drinking water may have increased risk of getting cancer over the course of their lifetime, especially lung cancer. Radon in soil under homes is the biggest source of radon in indoor air, and presents a greater risk of lung cancer than radon in drinking water. As required by the Safe Drinking Water Act, EPA has developed a proposed regulation to reduce radon in drinking water that has a multimedia mitigation option to reduce radon in indoor air.

The unique multimedia framework for this proposed regulation is outlined in the Safe Drinking Water Act as amended in 1996:

1. First Option: States can choose to develop enhanced state programs to address the health risks from radon in indoor air -- known as Multimedia Mitigation (MMM) programs -- while individual water systems reduce radon levels in drinking water to 4,000 pCi/L or lower (picoCuries per liter, a standard unit of radiation). EPA is encouraging States to adopt this option because it is the most cost-effective way to achieve the greatest radon risk reduction.

2. Second Option: If a state chooses not to develop an MMM program, individual water systems in that state would be required to either reduce radon in their system's drinking water to 300 pCi/L or develop individual local MMM programs and reduce levels in drinking water to 4000 pCi/L. Water systems already at or below 300 pCi/L standard would not be required to treat their water for radon.

3.6.4.5 Arsenic Rule

In January 2001, the outgoing Clinton administration passed a proposed arsenic standard of 10 ppb. Upon entering office, the Bush administration temporarily suspended the proposed standard and kept it at 50 ppb until further studies could confirm the health risk of arsenic. In October of 2001, the Bush administration upheld the 10 ppb standard. This drastic reduction can be expected to be a great expense for a number of utilities around the country.

3.6.4.6 Radionuclide Rule

EPA has updated its standards for radionuclides in drinking water. EPA also has set a new standard for uranium, as required by the 1986 amendments to the Safe Drinking Water Act. The standards are: combined radium 226/228 (5 pCi/L); beta emitters (4 mrems); gross alpha standard (15 pCi/L); and uranium (30 μg/L). The rule goes into effect in December of 2003. Table 3.6 summarizes the MCL, potential health risks and monitoring requirements for radionuclides.

Table 3-6 Radionuclides Summary

Regulation	Maximum Contaminant Level (MCL) - (mg/L unless otherwise noted)	Potential Health Effects
Gross Alpha Particles	15 pCi/L	Cancer Risk
Beta Particles and Photon Emitters	4 mrem/yr	Cancer Risk
Radium 226 and Radium 228 (Combined)	5 pCi/L	Cancer Risk
Uranium	30 Mg/L (as of 12/08/03)	Cancer Risk, Kidney Toxicity

Monitoring Requirements

Gross Alpha Particles, Combined Radium 226/228, and Uranium - Initial monitoring will be required for four (4) consecutive quarters. Reduced monitoring and increased monitoring schedules may be instituted based on initial results. For more detailed information regarding reduced or increased monitoring schedules visit www.epa.gov.

Beta Particle and Photon Radioactivity - No monitoring required for Community Water Systems (CWSs). Initial quarterly sampling for Gross Beta and annual sampling for Tritium and Strotium-90 are required for vulnerable CWSs. Reduced monitoring and increased monitoring schedules may be instituted based on initial results. For more detailed information regarding reduced or increased monitoring schedules visit www.epa.gov.

Comments:

All samples must be collected at each entry point to the distribution system. The rule also contains requirements for using waters contaminated by effluents from nuclear facilities. When allowed by the State, data collected between June, 2000 and December 8, 2003 may be used to satisfy the initial monitoring requirements if samples have been collected from authorized locations in the distribution system.

3.6.4.7 Other Rules

Appendix F provides additional information relative to the following:

Consumer Confidence Reports

Filter Backwash and Recycling Rule

LT1ESWTR

Groundwater Rule

LT2ESWTR

Stage I and II D/DBP Rule

Also provided in Appendix G is a table summarizing the USEPA and NHDES Drinking Water Standards relative to the Regulations presented above and the status of each regulation.

3.6.5 Cost to Meet Future Regulations

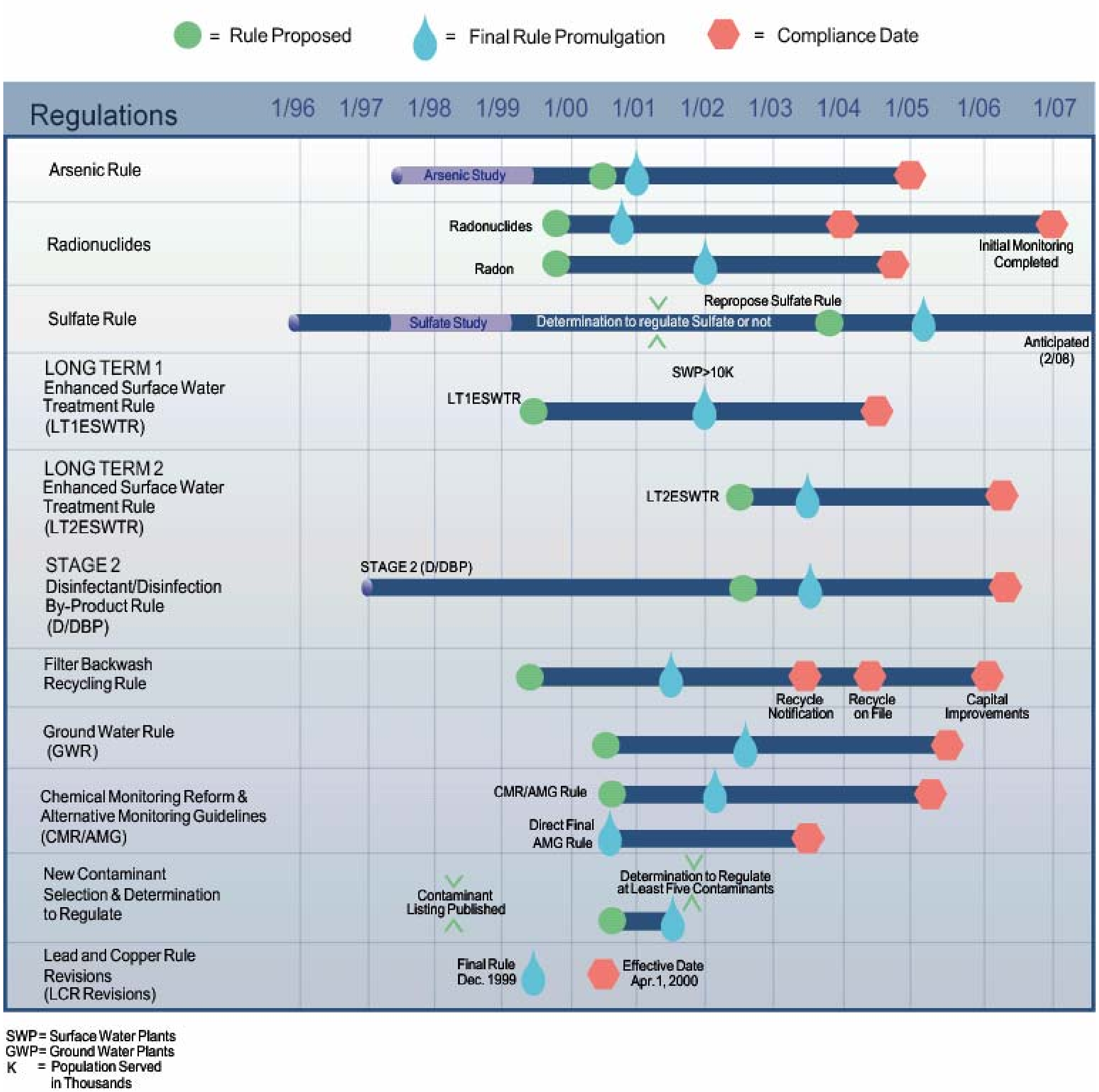
With increasing regulation and water quality reporting, as well as the ongoing need for the consumer confidence report, the monitoring, regulatory and reporting requirements are anticipated to increase with time. These trends are coupled with the advances in security and vulnerability assessments for the water industry. Historically, security and vulnerability considerations were accomplished simply with fencing and typically, a lock. In the future, more significant measures, in the distribution system quality, instrumentation, surveillance equipment, and security provisions will be instituted over time. For a system of this size, the security aspects may entail over $1 million worth of improvements. The ongoing security and vulnerability costs may escalate over the next ten years from an initial amount in the order of $100,000 per year to three times that amount. The additional analytical testing and other related activities may involve capital outlays in the order of $100,000 to $200,000 and ongoing operational costs of $10,000 the first year, increasing to $50,000 over and above present levels of funding after ten years.

Major capital improvements for the water treatment facilities in the 2002 to 2008 time period may need to focus significantly on filtration improvements and process optimization improvements. The costs involved in these areas may range from $2 million to $12 million, depending upon the final capital improvements and the determinations of regulatory entities over time concerning compliance with future regulations, grandfathering, or accepted modifications. Such improvements would have an ongoing operation and maintenance cost varying from $40,000 per year to $1 million per year, depending on capital improvements and the approach that is required to attain compliance.

The above cost estimates are projections for future regulatory compliance based upon anticipated water regulations that have either been promulgated or been discussed for rulemaking in the 2002 to 2010 timeframe. It is anticipated that several regulatory requirement dates which are projected for compliance in the 2003/04 timeframe may slip to later dates for compliance. The same may be true for other compliance dates under the Safe Drinking Water Act. In addition, we anticipate that additional regulations over and above those shown on Figure 3.4, will be added to the list as the Act requires additional regulations to be instituted over time.

The above does not provide for deferred maintenance, renewals and replacements that are necessary for assets which are marginally functional, becoming economically obsolete, and/or are reaching their average service lives for function within the utility system, or deficiencies in the water system owned by the Pennichuck Water Company. Those costs are the subject of other sections of this report, as well as other sections for future reports. These capital management issues have not been addressed due to the scope of services provided at this stage.

Figure 3.4
Schedule For Future Regulations



Hartman & Associates, Inc.

3.7 Capital Improvements Plan

The Capital Improvements Plan for Pennichuck Water Works for the years 2002 and 2006 are presented in the table included in Appendix H. This includes expenditure for the treatment plant upgrades, supply ponds and watershed improvements, and distribution system infrastructure replacement. **The Capital Improvements Plan does not include the following:**

- Costs for filtration system replacement/upgrades that are necessary for compliance with the impending regulations on water quality
- Costs for dredging the Supply Pond Chain System
- Costs required for land acquisition and/or purchase of development rights in the buffer zones and drainage area
- Cost for more significant measures in the distribution system quality, instrumentation, surveillance equipment, and security provisions

The Capital Improvements Plan allocates $ 6.4 million for the year 2002 that decreases to $ 3.6 million for the year 2006, excluding administration, data processing, community water systems, Pittsfield, and Pennichuck East.

Based on the evaluations of the existing core system of Pennichuck Water Works the recommended Capital Improvements Plan is presented in Table 3-7 below. The Plan is presented for a 30-year period between 2002 and 2032.

The Pennichuck Water Works Capital Improvements Plan (CIP) presented in Appendix H has been broken down into those improvements associated with the core system. Table 3.8 below compares the total 5 year cost of the Pennichuck Water Works Capital Improvements Plan to the Recommended Plan presented for the next five years. Since the Pennichuck Water Works CIP only projects out for the next five years, subsequent years were not compared.

Table 3-7 Recommended Capital Improvements Plan (In Million Dollars)

Implementation	2002-2007	2008-2012 [3]	2013-2017 [3]	2018-2022 [3]	2023-2027 [3]	2028-2032 [3]
Dredging Supply Pond Chain System (See Section 3.1)	$ 11.4	$ 12.9				
Future Supply Source	Unknown					
Direct Connection from the Merrimack River Intake Line	$ 1.5					
Upgrades to the Merrimack River Intake Facility		$ 5.4				
Implementation of Recommendations - Watershed Management Plan (See Section 4.2)	$ 2.4	$ 1.5	$ 1.7	$ 1.9	$ 2.2	$ 2.5
Treatment Plant Replacements[1] (See Section 3.3)	$ 1.2	$ 1.4	$ 1.6	$ 1.8	$ 2.0	$ 2.3
Treatment Plant Upgrades to Meet Future Demands	Unknown					
Distribution System Replacement[1] (See Section 3.4)	$ 13.7	$ 15.5	$ 17.5	$ 19.9	$ 22.5	$ 25.6
Upgrades Based on Future Regulations[2] (See Section 3.6)	$ 8.7	$ 0.7	$ 0.8	$ 0.9	$ 1.0	$ 1.2
Security Improvements[2] (See Section 3.6)	$ 1.5	$ 0.6	$ 0.7	$ 0.8	$ 0.9	$ 1.0
Total	**$ 40.1**	**$ 33.1**	**$ 22.3**	**$ 25.3**	**$ 28.6**	**$ 32.6**

1 Includes replacement of those items within the Nashua system that are 10 year old or older. Newer items have not been included in this cost.
2 Refers to cost for the core system of Pennichuck Water Works (Nashua, Hollis, Merrimack, Milford and Amherst)
3 Future costs estimated at a rate of 2.5% per year

Table 3-8 Capital Improvements Comparison 2002 – 2007 (In Million Dollars)

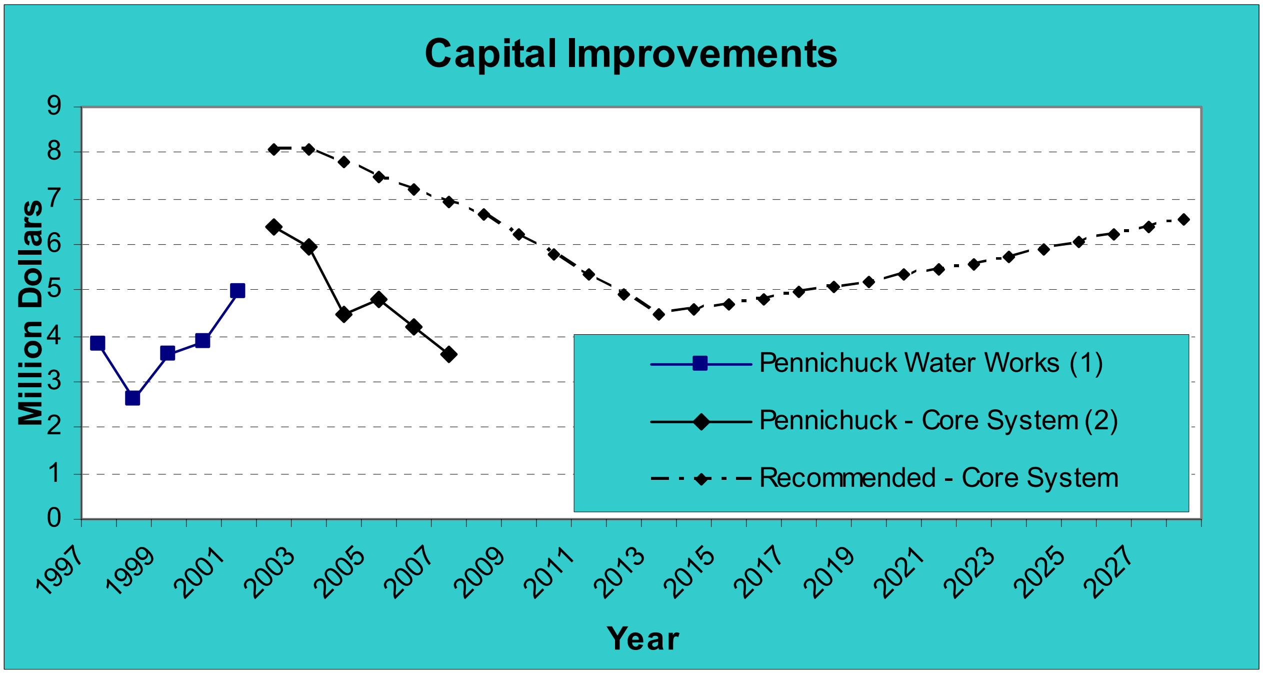
	Pennichuck Water Works (Core System)[1]	Recommended Improvements
Dredging Supply Pond Chain System	$ 0	$ 11.4
Future Supply Source	$ 0	Unknown
Supply & Watershed Improvements	$ 1.5	$ 0
Direct Connection from the Merrimack River Intake Line	$ 0	$ 1.5
Upgrades to the Merrimack River Intake Facility	$ 0	$ 0
Implementation of Recommendations - Watershed Management Plan	$ 0	$ 2.4
Treatment Plant Replacements	$ 7.8	$ 1.2
Treatment Plant Upgrades to Meet Future Demands	$ 0	Unknown
Distribution System Replacement	$ 16.2	$ 13.7
Upgrades Based on Future Regulations	$ 0	$ 8.7
Security Improvements	$ 0.3	$ 1.5
Total	**$ 25.8**	**$ 40.4**

1 Taken from Exhibit K, Pennichuck Corporation and Subsidiaries, 2002 through 2006

Figure 3.5 below presents the total previous capital improvements implemented by Pennichuck Water Works over the last five years, proposed capital improvements for the core system of Pennichuck Water

Works and the capital improvements recommended in this document for the core system.

Figure 3.5 Capital Improvements Plan



1 Taken from "Summary of Monthly Capital Expenditures," Pennichuck Water Works, Inc. 1997 - 2001.

2 Taken from Exhibit K, Pennichuck Corporation and Subsidiaries, 2002 through 2006

As shown in Figure 3.5, the previous improvements are well below the future trend of Pennichuck and the recommended improvements. Also, the trend for Pennichuck over the next 5 year plan is to decrease capital improvement dollars, while the recommendations provided in this report include some up front capital improvements in the first 5 to 10 years and then have a plan that maintains capital improvement dollars, which gradually increases over the next 30 years based on inflation.